WE CLAIM

1. A method for engineering of a connection in a WDM photonic network with a plurality of flexibility sites connected by links, comprising:

(a) calculating a physical end-to-end route between a source node and a destination node;

(b) setting-up a communication path along said end-to-end route;

(c) testing an operational parameter of said communication path; and

(d) comparing said operational parameter with a margin tolerance and declaring said communication path as established, whenever said operational parameter is above said margin tolerance.

2. A method as claimed in claim 1, further comprising (e) continuously monitoring said established communication path by measuring and comparing said operational parameter with a churn threshold.

3. A system as claimed in claim 1, wherein said margin tolerance is determined based on a communication path start of life margin value.

4. As system as claimed in claim 3, wherein said start of life margin value is a negotiated value based on potential network performance degradation during the life of said communication path.

5. As system as claimed in claim 2, wherein said margin tolerance and said churn threshold are each a negotiated value based on the cost of said communication path and potential network churn.

6. A method as claimed in claim 2, wherein said churn threshold is preset by averaging a plurality of values measured for said operational parameter during fast and slow variances in operation of said network.

7. A method as claimed in claim 2, wherein said churn threshold is determined by integrating a plurality of values measured for said operational parameter over a time interval.

8. A method as claimed in claim 1, further comprising, whenever said operational parameter is under said margin tolerance:

detecting a free regenerator at a flexibility site along said end-to-end route;

improving said operational parameter by inserting said free regenerator in said communication path;

marking said free regenerator as allocated to said communication path; and

performing steps (b) to (d).

9. A method as claimed in claim 2, further comprising:

abandoning said communication path if said operational parameter cannot be improved above any of said margin tolerance and said churn threshold;

calculating a new end-to-end route; and

performing steps (b) to (d).

10. A method as claimed in claim 2, wherein said operational parameter is any of the end-to-end Q value and the BER of said communication path.

11. A method for dynamic engineering of a communication path in a WDM photonic network with a plurality of flexibility sites connected by links, comprising:

(a) calculating a physical end-to-end route for connecting a source node and a destination node over said WDM network;

(b) setting-up communication path along said end-to-end route;

(c) testing an operational parameter of said communication path; and

(d) comparing said operational parameter with a test threshold and declaring said communication path as established, whenever said operational parameter is above said test threshold.

12. A method as claimed in claim 11, further comprising (e) continuously monitoring said established communication path by measuring and comparing said operational parameter with a maintenance threshold.

13. A system as claimed in claim 12, wherein said performance parameter is the quality factor Q of said communication path and said test threshold and said maintenance threshold are selected.

14. A method as claimed in claim 12, further comprising, whenever said operational parameter is under any of said test threshold and said maintenance threshold, selecting a new end-to-end physical route for said communication path and repeating steps (b) to (d).

15. A method of switching a communication path at a node of a photonic network, comprising:

routing said communication path from an input port of said node to an output port, whenever an operational parameter of said communication path is above a threshold; and

OEO processing said communication path at said node, whenever said operational parameter is under said threshold.

16. A method as claimed in claim 15, wherein said step of OEO processing comprises:

assigning to said communication path a regenerator from a pool of regenerators available at said node;

blocking said communication path from passing through said node in optical format; and

switching said communication path through said regenerator for regenerating the data signal carried by said communication path for conditioning said operational parameter above said threshold.

17. A method as claimed in claim 15, wherein said step of OEO processing comprises:

assigning to said communication path a regenerator from a pool of regenerators available at said node;

blocking said communication path from passing through said node in optical format; and

switching said communication path through said regenerator for changing the wavelength of said communication path for conditioning said operational parameter above said threshold.

18. A communication path for connecting a source node with a destination node along one or more intermediate nodes of a photonic network, said communication path operating in one of a monitoring mode and a maintenance mode, according to a path operational parameter.

19. A communication path as claimed in claim 18, wherein operation of said communication path changes from said monitoring mode to said maintenance mode, whenever said operational parameter is below a churn threshold.

20. A communication path as claimed in claim 18, wherein operation of said communication path changes from said maintenance mode to said monitoring mode, whenever said operational parameter is above a margin tolerance.

21. A communication path as claimed in claim 20, wherein said operational parameter is improved above said margin tolerance by inserting a regenerator in said path at an intermediate node.

22. A communication path as claimed in claim 19, wherein said operational parameter is improved above said churn threshold by inserting a regenerator in said path at an intermediate node.

23. A photonic network for routing a communication path between a source node and a destination node along a route passing through an intermediate node, comprising:

a pool of wavelength-converter/regenerators connected at said intermediate node;

a line control system for collecting performance information on said communication path; and

a network management system for assigning a wavelength-converter/ regenerator from said pool to said communication path and switching said communication path through said wavelength-converter/regenerator, whenever the performance of said communication path is outside an operation range.

24. A method of engineering a connection between two terminals of a dynamically reconfigurable photonic network, comprising:

setting-up a path whenever an operational parameter of said path is above a test threshold;

operating said path in monitoring mode whenever said operational parameter is above a maintenance threshold; and

servicing said path whenever said operational parameter is under said maintenance threshold.

25. A method as claimed in claim 24, wherein the step of setting-up comprises;

selecting a physical route for said path based on network topology information, resources specifications and path selection rules;

assigning 'n' wavelength to said path based on wavelength selection rules and the number 'm' of regenerators connected in said path;

lighting-up said path and measuring said operational parameter;

comparing said operational parameter with said test threshold; and

transiting the state of said path form set-up to established if said operational parameter is above said test threshold.

26. A method as claimed in claim 25, further comprising switching a wavelength-converter/regenerator device into said path whenever said operational parameter is under said test threshold.

27. A method as claimed in claim 25, further comprising selecting a new physical route and switching said path along said new route whenever said operational parameter is under said test threshold.

28. A method as claimed in claim 24, wherein the step of operating said path in a monitoring mode comprises:

continuously measuring said operational parameter;

continuously comparing said operational parameter with a maintenance threshold; and

switching a wavelength-converter/regenerator device into said path whenever said operational parameter is under said maintenance threshold.

29. A method as claimed in claim 28, further comprising transitioning from said operational state to a tearing down state if said operational parameter is under said margin tolerance after said device has been switched into said path.

30. A method as claimed in claim 24 wherein the step of operating said path in a monitoring mode comprises:

continuously measuring said operational parameter;

continuously comparing said operational parameter with a maintenance threshold; and

selecting a new physical route and switching said path along said new route whenever said operational parameter is under said maintenance threshold.

31. A method of engineering a connection over a WDM photonic network with a plurality of flexibility sites, comprising:

selecting a communication path for said connection based on network topology information, resources specifications and class of service constrains;

turning on a source transmitter, a destination receiver and all transmitters and receivers at all flexibility sites along said path;

increasing gradually the power level of said transmitters while measuring an error quantifier at said destination receiver; and

maintaining the power at said transmitters at a first level corresponding to a preset error quantifier.

32. A method as claimed in claim 31, further comprising:

operating said path in a monitoring mode by continuously measuring the error quantifier at said destination receiver;

increasing the power level of said transmitter from said first level while measuring the error quantifier at said destination receiver; and

maintaining the power level for said connection at a second level where said error quantifier is below said preset error quantifier.

33. A control system for engineering connections in a photonic switched network, with a plurality of wavelength cross-connects WXC connected by links comprising:

a plurality of control loops, each for monitoring and controlling a group of optical devices, according to a set of loop rules;

a plurality of optical link controllers, each for monitoring and controlling operation of said control loops provided along a link;

a plurality of optical vertex controllers, each for monitoring and controlling operation of said control loops provided at a wavelength cross-connect; and

a network connection controller for constructing a communication path within said photonic switched network and for monitoring and controlling operation of said optical link controller and said optical vertex controller.

34. A control system as in claim 33, wherein each said control loop receives specifications, state and measurements information from all optical devices of said group and controls operation of each said device according to preset span operational parameters.

35. A control system as in claim 33, wherein said optical link controller receives specifications, state and measurements information from all said control loops and controls said control loops based on loop control specifications.

36. A method as claimed in claim 35, wherein said loop control specifications include fiber specifications information and power targets.

37. A method as claimed in claim 35, wherein said optical link controller further receives loop turn-up measurements and loop alarms.

38. A control system as claimed in claim 35, wherein said control loops are one of a gain loop, a vector gain loop, a power loop and a vector power loop.

39. A control system as claimed in claim 38, wherein said gain loop operates using input/output sampling with a gain target.

40. A control system as in claim 38, wherein said vector gain loop operates using 'n' input/output sampling with an n-dimensional target.

41. A control system as claimed in claim 33, wherein each said control loop operates in a transparent propagation mode and a response mode.

42. A control system as claimed in claim 41, further comprising coupling a plurality of control loops based on a coupling coefficient, wherein said coefficient is selected so as to allocate the response of said coupled loops to the appropriate set of loops and in the correct order.

43. A control system for engineering connections in a photonic switched network, with a plurality of wavelength cross-connects WXC connected by links comprising:

a plurality of control loops, each for monitoring and controlling a group of optical devices, according to a set of loop rules;

an engineering tool for receiving measurement data and information on said control loop state from each said control loop, importing information on said control loop model from a performance and monitoring database, and

providing said control loop with a range for the input signal and a target for the output signal.